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Cross-references: None

Statement regarding the use of federal funds

No federal funding, direct or indirect, has been utilized in conjunction with the development of the present invention.

Statement regarding microfiche records

No microfiche records are used in the application submitted for the present invention.

Prior Art

No prior art can be found which discloses the present invention. Historically the status of drive train components, of anti-locking brake system components, power usage by vehicle components, and/or of the proximity to a roll over condition have not been displayed for the driver by any type of vehicle. US Patent 6,398,688, by Brown, et al, however discloses a visual display in Figure 1 but without elaboration in the specification. Further US Patent number

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1 6,497,301 by Iida, et al discloses an indicator 25 and alarming lamp and alarm 26 in Figure 1
2 without further elaboration in the specification. Regarding the same type of disclosure,
3 reference is made to US Patent number 6,493,623 Nishida, et al. US Patent number
4 6,603,393 by Sumada, et al discloses a display for a vehicle operator for functional status of
5 the vehicle but only mentions an open hood latch. No mention is made of the dynamics of
6 operation of the vehicle. One useful embodiment of the present invention is the dynamic or
7 real time display of the relative amounts of torque being transferred to the axles of a four-wheel
8 drive vehicle. This information is currently unavailable to vehicle operators. No patents, no
9 publications and no known application disclose the method, system, process, apparatus or the
10 types of displays disclosed herein by the present invention.

Summary of the Invention

1 The present invention is an apparatus, method, process and system for displaying real-
2 time operational information about a motor vehicle to the driver. The invention specifically
3 relates to the display of the status of systems involving the anti-lock braking system, the
4 stability of the vehicle as to proximity to rolling over, the power consumed by vehicle
5 components such as the heating system and lights and/or, for four-wheel drive vehicles, the
6 torque and/or braking forces delivered to the wheels. The information is acquired from sensors
7 and/or from signals generated by the vehicle and is processed by the vehicle CPU or, in
8 another embodiment by a display CPU. The processed information is then displayed for the
9 driver in black and white or in color using an LED, LCD, vacuum florescent means, numerical
10 display, gauge or meter.

11 The preferred images used in said display to convey said operating parameters are
12 meaningful, symbolic, easily understood and spare in style. The presentation is in either black
13 and white or color and the variety of types of display devices enumerated all generally serve to
14 adequately display the needed information. Audible signals and/or warnings can be used to
15 augment these visual presentations. The preferred displays are time-variant, concise and
16 appropriate for the information presented and include a proportional symbolic display, bar
17 charts, a segmented bar chart, variable-size or variable-shape icon or images.

18 These and other objects and advantages of the present invention will become clear to
19 those skilled in the art in view of the description of the best presently known mode of carrying
20 out the invention and the applicability of the preferred embodiment as described here in and as
21 illustrated in the several figures of the drawings.

Description of the Drawings

Figure 1	Scalar bar diagram image
Figures 2-4	Braking display wheel images
Figure 5A	Delivered torque display wheel image
Figures 5B, 5C	Combination of torque and braking display wheel images
Figures 6A, 6B, 7A, 7B	Relative torque or speed display wheel images
Figures 8A, 8B	Diagrams of component monitoring, data processing and image display.
Figure 9	Diagram of clutch monitoring, data processing and image display
Figures 10A, 10B	Inline connector and inserted coil
Figures 10C, 10D	Clamping induction coil
Figure 10E	In-line current sensing device
Figures 11A, 11B	Diagrams of ABS system monitoring, data processing and image display
Figures 12A, 12B	Diagrams of accelerometer and harmonic frequency sensors, data processing and image display
Figure 13	Torque display image
Figure 14	Diagram of wheel load sensor
Figures 15, 16	Torque display images
Figure 17A, 17B	Component power consumption display images
Figures 17C, 17D	Bar chart pie segment display images
Figure 18A, 18B	Diagrams of power component monitoring, data processing and image display
Figures 19A, 19B	Turn over display images
Figure 20	Diagram of display CPU function processing

Specification

1 The best known method for the presentation of graphical information to the driver of a
2 motor vehicle regarding specific real-time operating parameters of the vehicle using display
3 devices is the present invention. These specific real-time operating parameters are defined as
4 the operation of an anti-lock braking system (ABS) and/or the behavior of the vehicle as to
5 stability, that is, to the proximity to rolling over and/or operation of a vehicle as to the power
6 consumed by vehicle components and/or, for four-wheel or all-wheel drive vehicles, operation
7 of the vehicle as to the torque and/or braking forces delivered to the wheels (which are not
8 limited to these factors).

9 The sophisticated manner in which a modern four-wheel drive vehicle's controlling CPU
10 distributes torque to the wheels obscures the details of transferred power by transforming the
11 vehicle's performance into a seamless and uniform continuity, regardless of road conditions.
12 Variations in a wheel's traction due to a slippery surface result in the delivery of less power to
13 the wheel to avoid slippage. This invisible and comprehensive management of power
14 distribution greatly eases the burden of driving in dangerous situations. However many drivers
15 would like to have, and frequently would benefit from viewing, displayed information regarding
16 the real-time operation of the vehicle and the control system. It is to the presentation of this
17 type of operational information that the present invention is oriented. The various data
18 acquisition means, the related computational processes, the variety of display devices which
19 can be utilized in real time and the various graphical symbols and forms together with their
20 real-time variations are used to present said operating parameters and comprise the essence
21 of the present invention. The manner of accelerating, braking and/or steering by a driver, affect
22 a vehicle's performance. The dynamic display of these parameters therefore is also within the
23 scope of the present invention (which is not limited to these factors).

1 The preferred images used in said display to convey said operating parameters are
2 meaningful, symbolic, easily understood and spare in style. The presentation is in either black
3 and white or color and the variety of types of display devices enumerated all generally serve to
4 adequately display the needed information. Audible signals and/or warnings can be used to
5 augment these visual presentations. The preferred displays are time-variant, concise and
6 appropriate for the information presented and include a proportional symbolic display, bar
7 charts, a segmented bar chart and variable-size or variable-shape icons or images. Time-
8 variant changes in color, hue, shading, density of cross hatching, contrast, content, shape,
9 orientation, pattern and/or illumination of an image as a function of one or more of said
10 operational parameters are defined as a time-variant highlighted image (which are not limited
11 to these variants).

12 For four-wheel drive vehicles, the signals from a vehicle's CPU control the amount of
13 torque and/or braking delivered to each wheel and are one source for calculating torque-related
14 and/or braking-related display information. Another method for obtaining such information is
15 by the measurement of variations in the flux produced by electromagnetic clutches which are
16 commonly used by four-wheel drive vehicles to deliver power and/or braking to a wheel. Yet
17 another method for obtaining this information is the monitoring of the signals from said vehicle
18 CPU to the controlling electromagnetic clutches with a clampon or an incline induction coil
19 monitor around the conductor of these signals or with a signal measuring means inserted in
20 series into the conductor of these signals.

21 Some four-wheel vehicles have fixed differential power delivery means for the front pair
22 of wheels and deliver variable amounts of power, up to half of the total, to the rear wheels.
23 Other four-wheel vehicles have fixed differential power delivery means for the rear pair of
24 wheels and deliver variable amounts of power, up to half of the total, to the front wheels. Other

1 systems in use rely upon fluid clutch arrangements which deliver a variable amount to the front
2 or rear pair of wheels or which deliver different amounts to each wheel.

3 The symbolic display of the relative or absolute power usage by the vehicle's power
4 consuming components with appropriate symbols is useful and novel. Said vehicle power
5 consuming components include lights, stereo equipment, air conditioner, cruise control, a
6 heater, a winch and a power takeoff (which are not limited to these components).

7 To understand the range of applications and the details of implementing the present
8 invention, reference is made to the drawings. Referring particularly to the figures wherein like-
9 referenced numbers have been applied to like-parts throughout the description as illustrated in
10 the several figures of the drawings. Said operating parameters are designated as reference
11 number 82 and one or more of said highlighted items is designated as reference number 16.

12 Two modes of data acquisition, processing and display of said operating conditions of a
13 vehicle 63 are encompassed by the present invention. These are (1) signals derived from
14 vehicle sensors and/or display signals produced by or derived from a vehicle CPU 32 and
15 which are presented as a display image indicated by the general reference number 11 on said
16 vehicle's display panel 75 and (2) data signals generated by sensors, said sensors monitoring
17 specific vehicle functions and signals. Said data signals being processed by a display CPU 36
18 and producing display signals, said display signals being displayed as said display image 11
19 on a display device 30 mounted inside said vehicle 63 in view of the driver. Said display
20 device 30,75 includes an LED, LCD, vacuum florescent means, numerical display, GPS
21 display and/or trip computer, gauge or meter. Alternately, said display device 30 is a hand
22 held computer, also called a PDA (and is not limited to these means).

23
24 Figures 1 and 2 are schematic views of said display image 11 within the enclosing
25 display outline of said display device 30,75. Figure 2 is a schematic display 11 of a drive train,

Figures 1 and 2 are schematic views of said display image 11 within the enclosing display outline of said display device 30,75. Figure 2 is a schematic display 11 of a drive train, comprised of drive train components 1,2,3,4,5,6,7,8,9,14, said display 11 comprised of said enclosing outline 30,75 within which is located a left front wheel 1 represented schematically by a rectangular outline and centrally connected by a front axle 7 represented by a horizontal line to a front transfer case 5 represented by an enclosed circular outline, a right front wheel 2 represented by a schematic rectangular outline and centrally connected by a second front axle 7 schematically represented by a horizontal line to said front transfer case 5, a left rear wheel 3 schematically represented by a rectangular outline and centrally connected by a rear axle 8 schematically represented by a line to a rear transfer case 6 represented by a circular outline, a right rear wheel 4, schematically represented by an rectangular outline and centrally connected by a second rear axle 8 and schematically represented by a line to said rear transfer case 6, a front-rear transfer shaft 9 schematically represented by a line extending from and connecting said front transfer case 5 to said rear transfer case 6, a power source 14 for said vehicle 63 schematically represented by an enclosed rectangular outline adjacent to, above and contacting said front transfer case 5, said front-rear transfer shaft 9 being centrally located together with the other drive train components 1,2,3,4,5,6,7,8,14 within said enclosing outline 30,75, said wheels 3,4 aligned vertically with said front-rear transfer shaft 9 and said wheels 1, 2 angled indicating left turned front wheels 1,2. As the angular position of the outlines of the front wheels 1,2 changes with time to reflect the steering angle of the front wheels 1,2, said image 11 is a variable image designated by the general reference number 77. Said variable image 77 is defined as an image which varies in time in size, shape or highlighting 16.

Figure 1 is a scalar bar diagram 52 for a four-wheel vehicle having at least one upper horizontal bar 12 and having at least one lower horizontal bar 13, said Figure 1 displaying four

1 upper bars 12 and four lower bars 13, said bars 12, 13 centrally located and centered within
2 said outline 30,75 and said upper bars 12 centered and progressively shorter in length with
3 lower position and said lower bars 13 centered and progressively longer with lower position,
4 said upper bars 12 indicating the amount of torque, if any, being transferred to the front wheels
5 1,2 and said lower bars 13 indicating the amount of torque, if any, being transferred to the rear
6 wheels 3,4, whereby the highest and longest of said upper bars being highlighted and
7 indicating transfer of torque only to said front wheels 1,2 and whereby the longest and lowest of
8 said lower bars 13 when highlighted 16 indicating transfer of torque only to said rear wheels
9 3,4, and whereby when torque is transferred to said front wheels 1,2 and to said rear wheels
10 3,4, one bar in each set of bars 12,13 is highlighted 16 in proportion to the relative torque
11 being transferred to said front wheels 1,2 and to said rear wheels 3,4. As shown, substantially
12 more torque is being transferred to the rear wheels 3,4 than to the front wheels 1,2.

13 Figures 3 and 4 are the upper portions of said drive train display 11,77 as shown in
14 Figure 2 in a braking situation within said enclosing outline 30,75. Figure 3 shows said
15 braking condition by action of the driver and/or by said vehicle CPU 32 by presenting short
16 parallel horizontal lines 10 extending outward from the inner and outer edges of each of said
17 outlines of said wheels 1,2. Figure 4 shows an alternative embodiment of said display 11 of
18 said braking condition by highlighted areas 16 shown within each of said outlines of said
19 wheels 1, 2. Figure 4 also shows a further embodiment of said display 11 of said braking
20 condition by presenting semicircular arcs 15, the bases of said semicircular arcs attached to
21 and extending away from either side away from each of said outlines of said wheels 1,2, it
22 being understood that the same presentations are also used for said rear wheels 3,4. Said
23 semicircular arcs represent passive braking using an engaged power source 14 to slow the
24 vehicle 63. Variations in the length or number of said lines 10 in Figure 3 indicating the

relative amount of braking on each wheel. Alternatively, the size of or number of said semicircular arcs 15 indicates the relative amount of braking.

Figure 5A is a schematic bar chart drive train display 11,49 as disclosed in Figure 2, bar chart indicators 41, 42, 43, 44 respectively highlighting the outlines of said wheels 1,2,3,4, the relative amplitudes 38 of said bar charts 41,42,43,44 indicating the relative amounts of torque respectively transferred to each of said wheels 1,2,3,4 being transferred to the right rear 4 wheel as shown is less than to the other wheels 1,2,3. In like manner Figure 5B presents a display 11,49 with delivered torque 38 extending upward from the middle of said outline 41,42,43,44 and Figure 5C presents a display indicating the braking force in the same bar chart 41,42,43,44 by an increase in amplitude 38 in the downward direction from the middle of said outline 41,42,43,44. Further, in Figure 1, the shading 16 within said outlines 41,42,43,44 represents the amplitude 38 of braking for each wheel with the right rear wheel 4 showing a reduced amount of braking due to the action of the controller 48 of an ABS system.

In another embodiment of the invention Figure 6A and Figure 7A are schematic views of an image 11,77 of one of said outlines of said wheels 1,2,3,4 as shown in Figure 2 comprised of at least one highlighted horizontal band 17, two of said at least one band being shown. Figures 6B and 7B are respective schematic views of said outlines of said wheels 1,2,3,4 at a time interval slightly after that shown in Figures 6A and 7A, Said at least one band 17 giving the appearance of moving downward, as viewed in successive images, indicating movement of said wheels 1,2,3,4, a greater number of said dark bands and/or a greater apparent downward speed as in Figures 7A and 7B indicating an increase in speed and/or indicating increased transfer of torque. The display of a greater area of said bands 17 in Figures 7A and 7B also indicating transfer of relatively more torque to a wheel. The rate of downward movement of said bands 16,17 in an outline of one wheel indicating a faster rotating wheel or slippage relative to the other wheels.

1 Figure 8A is a schematic diagram of a four-wheel vehicle as shown in Figure 2 and
2 having an enclosing outline 18 representing said vehicle 63, said drive train components,
3 1,2,3,4,5,6,7,8,9,14 centered within said outline 18 and further comprising a vehicle CPU 32,
4 said display device 75, at least one electromagnetic clutch 24, at least one controller 34 for
5 said at least one electromagnetic clutch 24 at or contained within said rear transfer case 6, at
6 least one connector 50 connecting said at least one controller 34 to said vehicle CPU 32, two
7 electromagnetic clutches 24 and two connectors 50 being shown, a wheel speed sensor 45 on
8 or at least one of said wheels 1,2,3,4, a wheel speed connector 46 connecting at least one of
9 said wheel speed sensors 45 to said vehicle CPU 32, a wheel steering angle sensor 22 on at
10 least one of said front wheels 1,2, at least one wheel steering angle sensor connector 23
11 connecting said at least one of said wheel steering angle sensor 22 to said vehicle CPU 36,m
12 said vehicle CPU 32 computing display signals, said display signals being conducted by a
13 connector 47 to said display device 11,75 for display.

14 Figure 9 schematically discloses the processing of information from at least one flux
15 sensor 35, a Hall effect sensor, affixed to said at least one electromagnetic clutch 24 in said
16 rear transfer case 6 by affixing means, said affixing means comprised of high temperature tape
17 20, said information conducted by a conductor 51 to said display CPU 36 and by said
18 conductor 39 transfers display information to said display device 11,30.

19 Figure 10A is a diagram of an incline connector 26 in a conductor 23,46,50. Figure
20 10B shows said conductor 23,46,50 with a toroidal coil 27 slid over the end of said conductor
21 23,46,50 when said incline connector 26 is unconnected, said incline connector 26 then being
22 reconnected. Said toroidal coil 27 then providing, by induction means through conductors 51,
23 a signal for processing by said display CPU 36. Figures 10C and 10D show an alternate
24 method of monitoring said wire 23,46,50 using a clamping induction coil 54 clamped over said
25 conductor 23,46,50. Figure 10E shows an in-line current sensor 83.

1 Figure 8B is a schematic diagram as in Figure 8A but showing one wheel 1,2,3,4 with a
2 steering angle sensor 22 connected by a conductor 23 to said display CPU 36 and an affixed
3 speed sensor 45 connected by a conductor 46 to said display CPU 36, said additional CPU 36
4 connected by a conductor 39 to said display device 30. Figure 14 shows a wheel load sensor
5 58 with data signals transmitted by a conductor 50. It being understood that said toroidal coil
6 terminating in conductors 51 as shown in Figure 10B or said clamping induction coil 54 as
7 shown in Figures 10C and 10D provide an alternate means of providing the signals from
8 conductors 23,46,50 from said sensors 22,45,58 to said display CPU 36 and by conductor 39
9 transfers display information from said display CPU 36 to said display device 30.

10 Figure 11A schematically shows, as in Figure 8A, at least one sensor 35 at and affixed
11 to the master brake cylinder and controller 28 and/or to the ABS controller 48 with brake lines
12 31 to the brake 29 at each wheel 1,2,3,4 and a connector 50 connecting said controller 48 to
13 said vehicle CPU 36 and by conductor 39 transfers display information from said display CPU
14 36 to said display device 30.

15 Figure 11B schematically shows, as in Figure 11A, a flux sensor 35 affixed to said
16 master brake cylinder and controller 28, a connector 51 from said sensor 35 to said display
17 CPU 36 and by said conductor 39, transfers display information from said display CPU 36 to
18 said display device 11,30. Said sensor 35 be affixed to said master brake cylinder and
19 controller 28 by affixing means, duct tape 20 being shown as an affixing means. It being
20 understood that said toroidal coil 27 terminating in conductors 51 as shown in Figure 10B
21 provides an alternate means of monitoring braking signals in said conductor 50 between said
22 vehicle CPU 32 and said master brake cylinder and controller 28, said toroidal coil leads 51
23 being connected to and transmitting said signal to said display CPU 36, said vehicle CPU 32
24 computing display signals, said display signals being conducted by a connector 47 to said
25 display device 75 for display.

1 In one embodiment as shown in Figures 13,15,16, the schematic outlines of said
2 wheels 1,2,3,4 are represented by rounded rectangles 1,2,3,4 within a display outline 30,75.
3 The net difference in torque or braking between adjacent pairs of wheels, 1,2 or 2,4 or 3,4 or
4 1,3, is displayed in by indicator bar 53 whose ends are situated within the boundary of each of
5 said pair of rounded rectangles 1,2,3,4. Said four indicator bars 53 are divided at their mid
6 points by a dividing dashed line 56. A relative increase in the delivered torque or braking to
7 one wheel is indicated by shading 54 extending from said divider 56 toward that wheel as a
8 form of a bar chart 16,38.

9 The stability of a vehicle is displayed as the proximity of a vehicle to rolling over to one
10 side or the other with a gravity or accelerometer direction sensor 37 together with a harmonic
11 frequency analyzer 19, as shown in Figure 12B is used by said vehicle CPU 36 to determine
12 the true center of gravity and to calculate the proximity of said vehicle 63 to rolling over. Said
13 resonance frequency sensor 19 calculates the true center of gravity by determining the
14 principal resonance frequency in a side to side resonance mode relative to the ground and the
15 gravity direction sensor 37 determines the true angle to one side or the other arising from a
16 combination of gravitational and acceleration forces resulting in production of information
17 transferred to said vehicle CPU 36, said vehicle calculating the net lateral acceleration force
18 vector 61 as shown in Figure 19A. Said display CPU 36 generates display information for said
19 display device 75 indicating proximity to a roll over condition. When said vector 61, acting from
20 the center of gravity 62 of the vehicle 63, falls outside the track of the wheels on one side, 1,3
21 or 2,4, the vehicle 63 will overturn. In like manner, Figure 12A shows information from said
22 sensors 19,37 conducted by conductors 51 to said display CPU 36, said display CPU 36
23 creating said display information and transmitting it by conductor 39 to said display device 30
24 for display as shown in Figures 16, 19A and 19B.

Figure 19A is a schematic rear view of an outline of a vehicle 63 with four wheels 1,2,3,4 resting on the ground 64, a center of gravity 62 indicator centered in an outline 18 of said vehicle 63 centered in said display outline 30,75, a vector arrow 61 from said center of gravity 62 angled downward toward the left side and ending outside of the wheel track of wheels 2,4 to the ground 64 on the left side of said vehicle 63. Alternately or in addition, the wheel pairs 1,3 and 2,4 can be highlighted 16 as in Figures 15, 16 to indicate a difference in the amount of loading of the wheels 1,2,3,4. The resulting image 11 has a variable shape 77. Figure 19B is another representation of the roll over condition shown in Figure 19A, wherein the outline 18 of the vehicle 63 encloses two sets of indicator bars, each of said set of indicator bars 21 commencing near the center of said outline 18 and with increasing size bars 21 positioned downward to either side, the lower of said indicator bars 21 being progressively larger and all bars 21 preferably being arc shaped. As shown the lowest leftmost indicator bar 21 being highlighted 16 indicating a potential roll over condition to the left side

Alternately, in another embodiment of a method or means for displaying proximity to a roll over condition, a load bearing sensor 58 on each wheel is monitored, with connectors 50 to said vehicle CPU 32 or with connectors 51 to said display CPU 36, as shown schematically in Figure 14 and presenting a display 11 as shown in Figures 13,15,16, of the difference in the loading on one side compared to the other side thus displaying the proximity of said vehicle 63 to rolling over. It is understood that the stability information required to present the images in Figures 13,15,16 can be obtained by the harmonic frequency sensor 19 and gravity direction sensor 37 as described above and shown in Figure 20. Alternately, the image 11 shown in Figures 19A and 19B can also be calculated and displayed from data acquired from said load sensors 58.

Figures 15 and 16 are similar to the presentation in Figure 13 but said rounded outlines of the wheels, 1,2,3,4 are highlighted 16 with the shading proportional the weight

borne by each wheel. Variations in highlighting 16 representing reduced or no loading on one side and proximity to a roll over condition. Figure 16 also includes information as to the steering angle of the front wheels 1,2 which information is acquired from at least one steering angle sensor 22 as shown in Figures 8A or 8B. The resulting image 11 has a variable shape 77.

Figures 17A is a display 11 of power consuming symbols with a background bar chart 49 associated with each symbol 65,66,67,68,69,25,33, said symbols comprising, a stereo system 65, an air conditioning system 66, a cruise control system 67, a heating system 68, a lighting system 69, a winch 26 and a power takeoff unit 33 (which is not limited to these components). In Figure 17B the same symbols 65,66,67,68,69,25,33 are presented with numerical values of associated power consumption rates adjacent to each of said power consuming symbols and said display 11 is termed a numerical display 80. Figure 17C presents the same information in a pie chart with radial bar chart elements as background to each symbol 65,66,67,68,69,25,33. Figure 17D is similar but only shows the power components, 65,68,69 in use. Figures 17C and 17D are termed bar charts 49 in pie segment format 78.

Figures 18A and 18B are diagrams of power consuming components, 65,66,67,68,69,25,33 connected by connectors 50 in Figure 18A to said vehicle CPU 32 and in Figure 18B by connectors 51 to said display CPU 36. Said vehicle CPU 32 is connected to display device 75 by connector 47 and said display CPU 36 is connected with display device 30 by connector 39.

Time-variant display image 11, as presented in the various figures, are defined as one or more of said bar charts 49, scalar bar diagrams 52, variable-size or variable-shape icons 77 and/or bar charts in pie segment format 78 (which are not limited to these images).

1 Figure 20 shows a schematic diagram of said vehicle CPU 32 or said display CPU 36
2 with said input signal 51 processed to produce said output signal 39 to said display device
3 30,75 whereby said input signal 51 is processed by an analog to digital (A/D) converter 57
4 producing a signal which is modified by a scalar module 72, said scalar processing module 72
5 comprised of a means to increase the delay or time constant of a peak response allowing said
6 peak to permit continuity in viewing said image 11 on said display 30,75, said scalar module
7 72 producing a signal which is modified by an image generation module 81, a reference data
8 module 76 providing image data to said image generation module 81, said image generation
9 module 81 providing input for a device formatting module 79 and said device formatting
10 module 79 providing said display data 39 to said display device 30,75 and said display device
11 30,75 displaying said displayed image 11. It being understood that said formatting means 79
12 is dedicated to a single type of display device 75 for said vehicle CPU 32 and to multiple types
13 of display devices 30 for said display CPU 36.

14 An alarm speaker 84 connected by a connector 85 to said vehicle CPU 32 or to said
15 display CPU 36 is shown in Figures 8A,8B,9,11A,11B,12A, 12B,18A,18B,20 and provides
16 audible signals to said operator of the status of vehicle operations.

17 The operation of the invention is as follows. A display 30,75 is mounted within view of
18 the driver of a motor vehicle 63 and the image displayed indicates the operation of an anti-lock
19 braking system (ABS) and/or the behavior of the vehicle as to stability, that is, to the proximity
20 to rolling over and/or operation of a vehicle as to the power consumed by vehicle components
21 and/or, for four-wheel drive vehicles, operation of the vehicle as to the torque and/or braking
22 forces delivered to the wheels 1,2,3,4. The sensor information required to provide this display
23 11 is obtained from a steering angle sensor 22 to determine the steering angle of the front
24 wheels, a flux sensor 35 for monitoring at least one electromagnetic clutch 24 to determine the
25 delivered torque to a wheel 1,2,3,4, a harmonic frequency sensor 19 to determine the center of

1 delivered torque to a wheel 1,2,3,4, a harmonic frequency sensor 19 to determine the center of
2 gravity of the vehicle 63 and a gravity direction sensor 37 to determine the proximity to roll
3 over, a wheel load sensor 58 at each wheel 1,2,3,4, an alternate means to determine the
4 proximity to roll over of the vehicle 63, a sensor 35 on the ABS controller 48 and/or the master
5 brake cylinder 28 monitoring the braking force delivered to the wheels 1,2,3,4 and/or sensors
6 26,54,83 monitoring the conductors 23,46,50 of signals containing this information and
7 provided to or generated by said vehicle CPU 32. A separate display CPU 36 and/or said
8 vehicle CPU 32 generate the display signals for a display device 30,75 producing an image 11
9 in the form of a scalar bar diagram 52, a schematic display of a drive train with components
10 1,2,3,4,5,6,7,8,9,14, with bar chart indicators 38 in the outlines of wheels 41,42,43,44 of
11 braking and/or delivered torque or by line extensions 10 from said outlines 41,42,43,44 or,
12 alternately, by passive braking by semicircles 15 on the sides of said outlines 41,42,43,44 or,
13 alternately, by moving bands 17 within said outlines 41,42,43,44, by displays of the relative
14 torque delivered by adjacent wheels, side to side 1,2 and 3,4 and/or front to back 1,3 and 2,4
15 with bar charts 38, stability of the vehicle 63 be displayed by variations in the shading 16 of the
16 outline of the wheels 1,2,3,4 or, alternately, by vector means 16 within a vehicle outline 18 or,
17 alternately, by arc indicators 21 within a vehicle outline 18 and the amount of absolute or
18 relative power consumption by vehicle components in bar charts 49 or, alternately, with
19 numerical displays 71 associated with component icons 65,66,67,68,69,25,33 or, alternately,
20 with bar charts in pie segment format 78 for all components or for only those components in
21 use. Said display device 30,75 includes an LED, LCD, vacuum florescent means, numerical
22 display, GPS display and/or trip computer, gauge or meter. Alternately, said display device 30
23 is a hand held computer, also called a PDA. Said shading or highlighting 16 includes time-
24 variant changes in color, hue, shading, density of cross hatching, contrast, content, shape,

1 orientation, pattern and/or illumination (which are not limited to these variants) of said image
2 11 as representative of the functioning of one or more of said operational parameters 82.

3 Thus it has been shown that an improved means for the display of operational
4 information for a vehicle can be accomplished. All of the above are only some of the examples
5 of available embodiments of the present invention. For example, an auto calibration or self
6 testing mode for standardizing the presentation of such information. The communication
7 means between said display CPU 36 and said display device 30 can be by infrared or wireless
8 means. The algorithms needed to convert given signals to meaningful display quantities vary
9 substantially but would be obvious to one skilled in the art for such applications. A means of
10 securement of the Hall effect sensors can be accomplished by a variety of attachment means
11 other than by using high temperature tape. The torque transferred to an axle can also be
12 determined by use of an induction coil or by a strain gauge. Those skilled in the art will readily
13 observe that numerous other modifications and alterations may be made without departing
14 from the spirit and scope of the invention. Accordingly, the above disclosure is not intended as
15 limiting and the appended claims are to be interpreted as encompassing the entire scope of
16 the invention.

Reference Numerals - Description

<u>Numeral</u>	<u>Description</u>
----------------	--------------------

- | | |
|-----|---|
| 1. | Left front tire |
| 2. | Right front tire |
| 3. | Left rear tire |
| 4. | Right rear tire |
| 5. | Front transfer case |
| 6. | Rear transfer case |
| 7. | Front axle |
| 8. | Rear axle |
| 9. | Front-rear transfer shaft |
| 10. | Braking indicator line |
| 11. | General reference number for a display |
| 12. | Upper display bar |
| 13. | Lower display bar |
| 14. | Power source |
| 15. | In-gear braking indicator |
| 16. | Highlighted item |
| 17. | Band, moving traction indicator |
| 18. | Vehicle outline |
| 19. | Harmonic frequency sensor |
| 20. | High temperature tape |
| 21. | Arc indicator |
| 22. | Wheel steering angle sensor |
| 23. | Wheel steering angle sensor connector |
| 24. | Electromagnetic clutch |
| 25. | Winch symbol |
| 26. | In-line connector |
| 27. | Toroidal coil sensor |
| 28. | Master brake cylinder and controller |
| 29. | Brake |
| 30. | Display device, mounted |
| 31. | Brake line |
| 32. | CPU, vehicle |
| 33. | Power takeoff symbol |
| 34. | Electromagnetic clutch controller |
| 35. | Flux sensor |
| 36. | CPU, display system |
| 37. | Accelerometer or gravity direction sensor |
| 38. | Bar chart amplitude |
| 39. | CPU connector |
| 40. | Negative bar chart amplitude |
| 41. | Bar chart, left front wheel |
| 42. | Bar chart, right front wheel |
| 43. | Bar chart, left rear wheel |
| 44. | Bar chart, right rear wheel |

- 45. Wheel speed sensor
- 46. Wheel speed connector
- 47. Connector, vehicle CPU
- 48. ABS controller
- 49. Bar chart
- 50. Connector to vehicle CPU
- 51. Connector to display CPU
- 52. Scalar bar diagram
- 53. Indicator bar
- 54. Clamping induction coil
- 55. Sound amplitude indication symbol
- 56. Bar chart divider
- 57. Analog to digital (A/D) converter
- 58. Wheel load sensor
- 59. Direction arrow
- 60. Vehicle lighting symbol
- 61. Net acceleration vector
- 62. Center of gravity of vehicle
- 63. Vehicle
- 64. Ground
- 65. Stereo system (speaker) symbol
- 66. Air conditioning system symbol
- 67. Cruise control symbol
- 68. Heating system symbol
- 69. Bar chart
- 70. Power sensor
- 71. Numerical display
- 72. Scalar module
- 73. Vector angle
- 74. Radial line
- 75. Vehicle display panel
- 76. Reference image data module
- 77. General reference number for variable-size or variable shape icon or image
- 78. Bar chart in pie segment format
- 79. Device formatting module
- 80. Numerical display
- 81. Image generation module
- 82. Operating parameters
- 83. In-line series current sensor
- 84. Alarm speaker
- 85. Alarm speaker connector